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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK VOLUME 150

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C-140 IN-FLIGHT CREW NOISE(U) AIR FORCE AEROSPACE

MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB. H K HILLE

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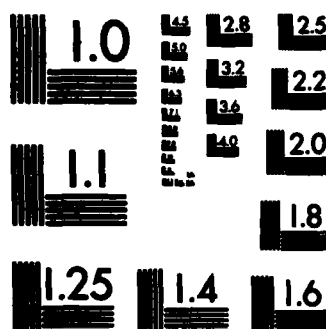
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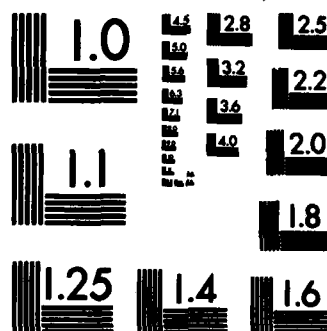
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AMRL-TR-75-50
Volume 150

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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 150

C-140 IN-FLIGHT CREW NOISE

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AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY
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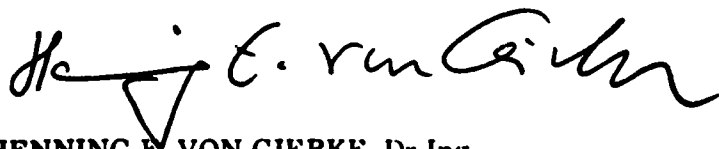
TECHNICAL REVIEW AND APPROVAL

AMRL-TR-75-50, Vol. 150

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



HENNING E. VON GIERKE, Dr Ing
Director
Biodynamics and Bioengineering Division
Air Force Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The C-140 is a USAF transport aircraft used for operational support. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this aircraft during normal flight operations. Data are reported for seven locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived			

noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol. 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Air Force Aerospace Medical Research Laboratory, under Project/Task 723109, Communication and Performance Capability and Operational Noises. The author acknowledges the efforts of Mr. John Cole who established the data analysis requirements, Mr. Henry Mohlman, and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.

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INTRODUCTION

The C-140 Jet Star is a transport aircraft used for operational support and is manufactured by the Lockheed-Georgia Company. The aircraft is powered by four J60-P-5A turbojet engines each rated at 3000 lbs. thrust. The engine is manufactured by the United Technologies Corp., Pratt & Whitney Aircraft Division.

This volume provides measured and extrapolated data defining bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the C-140 aircraft.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published.

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1. Cole, John N., USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application, AMRL-TR-75-50(1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured C-140 aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard C-140 environments, but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at various flight crew and passenger locations. Table 1 lists the measurement locations and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone position was at ear level external to headgear in a region 0.2-0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases, the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter and the resultant samples analyzed using a 4- or 8- second integration time to obtain a power-averaged level, which effectively smooths out short-duration fluctuations and best describes the exposure.

Although the presence of a crew member or passenger at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurement locations.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the C-140 aircraft at the seven specified locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1**MEASUREMENT LOCATIONS AND TEST CONDITIONS
C-140, ANDREWS AFB, 7 JUNE 1982**

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Pilot/Copilot	Seated Head Level
2	Flight Engineer/Navigator	Seated Head Level
3	First Row Seats, Centerline	40" Above Deck
4	Second Row Seats, Centerline	40" Above Deck
5	Third Row Seats, Centerline	40" Above Deck
6	Fourth Row Seats, Centerline	40" Above Deck
7	Pantry Aft of Aircraft	40" Above Deck

CONDITION	DESCRIPTION
A	APU Running - Cockpit Door + Aircraft Door Open
B	Ground Runup, Idle
C	Taxi
D	Ground Runup, Military
E	Takeoff/Roll
F	Lift Off, Gear Up, Climb to 3,000 ft.
G	Cruise, 4,000 ft. - 250 KIAS
H	Climb thru 13,000 ft. - .55M
I	Cruise, 28,000 ft. - Normal Speed
J	Cruise, 28,000 ft. - High Speed
K	Cruise, 17,000 ft. - High Speed
L	Cruise, 17,000 ft. - Medium Speed, 300 KIAS
M	Cruise, 11,000 ft. - 300 KIAS
N	Cruise, 11,000 ft. - 250 KIAS
O	Descending to 8,000 ft. - Flaps 20°
P	Descending to 3,000 ft. - Flaps 20°
Q	Approach, Gear Down, 1,000 ft. - Flaps 45°
R	Landing, Touch Down, Reverse Thrust

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:									
2																			
NOISE SOURCE/SUBJECT:										OMEGA 3.2									
C-140										TEST CD-082-001									
IN-FLIGHT CREW NOISE										RUN 03									
										20 JUL 82									
										PAGE F3									
										LOCATION/CONDITION									
FREQ (HZ)	5/J	6/J	7/J	1/K	1/L	1/M	1/N	1/O	1/P	1/Q	1/R								
25	73	70	71	73	74	74	72	73	69	75	85								
31.5	71	73	70	72	72	72	73	70	68	75	80								
40	72	74	74	70	70	72	75	69	70	76	83								
50	72	70	78	69	69	70	73	69	69	82	78								
63	91	80	97	82	79	82	79	82	71	69	78								
80	83	75	88	71	72	71	69	66	67	76	82								
100	90	74	74	67	67	71	69	64	65	72	75								
125	79	79	81	73	71	73	76	68	67	78	79								
160	74	72	77	66	65	65	71	58	64	80	76								
200	73	74	77	68	66	68	68	61	61	78	75								
250	90	77	83	71	70	70	75	62	61	74	75								
315	77	78	79	72	72	71	77	63	66	74	74								
400	90	80	80	73	72	72	74	65	68	74	77								
500	83	80	82	77	74	76	74	66	78	70	79								
630	83	84	85	81	80	80	76	71	80	68	80								
800	82	83	83	83	81	81	75	70	76	68	79								
1000	79	78	82	83	82	81	73	69	69	64	75								
1250	76	76	78	83	82	82	70	68	71	62	72								
1600	75	74	76	82	80	80	69	65	63	61	68								
2000	71	71	73	79	76	77	66	60	58	54	64								
2500	68	68	70	76	73	74	61	55	56	50	61								
3150	65	65	67	74	72	72	55	50	59	48	61								
4000	62	62	64	72	69	70	50	47	51	45	55								
5000	58	59	61	70	65	66	45	45	45	44	48								
6300	58	58	61	67	62	62	44	44	44	43	46								
8000	59	58	64	62	58	58	45	45	45	45	45								
10000	57	55	61	58	56	56	46	47	47	47	48								
OVERALL	94	91	99	91	90	90	87	81	85	89	92								

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)												
2 OCTAVE BAND												
IDENTIFICATION:												
OMEGA 3.2												
TEST CD-082-001												
RUN 01												
20 JUL 82												
PAGE J1												
NOISE SOURCE/SUBJECT: (OPERATION:												
C-140												
IN-FLIGHT CREW NOISE												
LOCATION/CONDITION												
1/A 2/A 1/B 2/B 3/B 1/C 1/D 1/E 1/F 1/G 2/G 1/H												
FREQ (HZ)												
31.5	70	73	70	66	71	84	83	95	81	77	76	80
63	67	67	74	66	70	82	82	93	83	77	84	83
125	73	78	83	80	74	77	80	90	76	73	76	73
250	72	77	74	72	70	71	81	83	74	73	76	71
500	77	81	68	73	69	72	84	81	78	83	82	80
1000	74	80	65	67	68	70	80	78	76	82	83	84
2000	70	77	60	64	63	69	72	73	71	77	80	81
4000	63	71	55	57	60	61	64	65	67	71	69	73
8000	61	68	54	54	56	54	63	59	65	61	62	63
OVERALL	81	86	85	82	79	87	90	98	87	88	89	89

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													
OCTAVE BAND													
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IDENTIFICATION:													
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) OMEGA 3.2													
) TEST CD-082-001													
) RUN 02													
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) 20 JUL 82													
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) PAGE J2													
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TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											
2											
OCTAVE BAND											
IDENTIFICATION:											
OMEGA 3.2											
TEST CD-082-001											
RUN 03											
20 JUL 82											
PAGE J3											
NOISE SOURCE/SUBJECT: (OPERATION:											
C-140											
IN-FLIGHT CREW NOISE											
LOCATION/CONDITION											
5/J 6/J 7/J 1/K 1/L 1/M 1/N 1/O 1/P 1/Q 1/R											
FREQ (HZ)											
31.5	77	77	77	76	77	77	78	76	74	80	88
63	92	81	98	82	83	80	82	74	73	84	84
125	83	81	83	74	73	76	78	69	70	83	82
250	82	81	85	75	75	75	79	67	68	81	79
500	87	87	87	83	81	82	79	73	82	76	83
1000	84	84	86	88	87	86	78	74	78	70	81
2000	77	76	78	84	82	83	71	66	65	62	70
4000	67	67	70	77	74	75	56	53	60	51	62
8000	63	62	67	69	64	64	50	50	50	50	52
OVERALL	94	91	99	91	90	90	87	81	85	89	92

TABLE: MEASURES OF HUMAN NOISE EXPOSURE										IDENTIFICATION:	
3										OMEGA 3.2	
NOISE SOURCE/SUBJECT: (OPERATION:										TEST CD-082-001	
C-140 ((((((((((((RUN 01	
IN-FLIGHT CREW NOISE ((((((((((((20 JUL 82	
((((((((((((PAGE H1	

TABLE: MEASURES OF HUMAN NOISE EXPOSURE										IDENTIFICATION:
3										OMEGA 3.2
										TEST CD-082-001
										RUN 02
										20 JUL 82
										PAGE 12
NOISE SOURCE/SUBJECT: OPERATION:										
C-140										
IN-FLIGHT CREW NOISE										
LOCATION/CONDITION										
	1/1	2/1	3/1	4/1	5/1	6/1	7/1	1/1	2/1	3/1 4/1
HAZARD/PROTECTION										
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR										
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR										
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)										
NO PROTECTION										
OASLC	90	89	91	88	91	89	91	98	93	91 91
OASLA	88	88	89	85	86	86	87	88	92	88 88
T	240	240	202	404	339	339	285	240	120	101 240 240
MINIMUM OPL EAR MUFFS										
OASLA*	64	62	64	64	66	65	67	73	66	67 66
T	960	960	960	960	960	960	960	960	960	960 960
U-51R EAR PLUGS										
OASLA*	63	62	63	62	63	62	64	66	66	65 65
T	960	960	960	960	960	960	960	960	960	960 960
FLENTS EAR PLUGS										
OASLA*	62	62	63	62	63	62	64	66	65	65 64
T	960	960	960	960	960	960	960	960	960	960 960
H-157 IN-FLIGHT COMMUNICATION UNIT										
OASLA*	66	64	66	65	67	66	68	74	69	68 68
T	960	960	960	960	960	960	960	960	960	960 960
COMMUNICATION										
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)										
PSIL	83	82	83	80	81	81	82	83	86	87 83 82
ANNOYANCE										
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)										
TONE CORRECTION (C IN DB)										
PNLT	100	100	101	96	97	97	99	102	105	105 99 99
C	1	1	1	1	1	1	2	1	1	1 1 1

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

